51106

CORRECTIVE AND REMEDIAL ACTION PROPOSED PLAN ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE OPERABLE UNIT 1 - 881 HILLSIDE AREA

United States Department of Energy
(U S DOE)

February 1995
Golden Colorado

DOE Announces Preferred Alternative For OU-1 Groundwater

The U S Department of Energy (DOE) has announced its preferred alternative to address contaminated groundwater at the Rocky Flats Environmental Technology Site (RFETS) Operable Unit 1 (OU 1) 881 Hillside Area The RFETS is located in Jefferson County Golden Colorado and is owned by DOE the lead agency for the site

The preferred alternative for groundwater beneath OU 1 is *Alternative 1 Institutional Controls with the French Drain* This alternative addresses the identified source of ongoing contamination in the operable unit and ensures protection of human health and the environment through groundwater extraction and treatment and natural degradation and attenuation of contaminants The alternative utilizes the existing ***French Drain*** part of the OU 1 ***Interim Measure/Interim Remedial Action*** (IM/IRA) Other alternatives considered include *Alternative 0 No Action Alternative 2 Groundwater Pumping and Soil Vapor Extraction Alternative 3 Groundwater Pumping and Soil Vapor Extraction with Thermal Enhancement Alternative 4 Hot Air Injection with Mechanical Mixing* and *Alternative 5 Soil Excavation with Groundwater Pumping*

All interested parties are encouraged to read and comment on this ***Corrective and Remedial Action Proposed Plan*** (PP) and to submit their comments to the persons identified below This PP has been prepared by DOE in cooperation with the Environmental Protection Agency (EPA) and the Colorado Department of Public Health and the Environment (CDPHE) pursuant to both the Resource Conservation and Recovery Act (RCRA) through the Colorado Hazardous Waste Act (CHWA) and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) This PP meets the requirements of CERCLA section 117(a) and of the Rocky Flats Interagency Agreement (IAG) between DOE EPA and CDPHE dated January 1991

Mark Your Calendar Opportunities for Public Involvement

Public Comment Period

Public Meeting Location

Public Meeting Time

Send Comments to
DOE External Aff Offi
P O Box 928
G ld n CO 80402-0928

Information Repositories
Rocky Flats Publ Read ng Room
Front R nge Community Coll g
Level B
3645 West 112th A nu
W stminst r CO 80030

Colorado Departm nt of Publi Health
nd th Environment
Hazard u M terials nd Waste
M nag m nt D n
4300 Cherry Creek Dri South
D v CO 80222

Colorad C u 1 n Rocky Fl ts
1536 Cole Boul vard Su t 150
Denv West Offi P k Bldg 4
Gold CO 80401

Sta dley Lake L brary
8485 Kipl ng
Arvada CO 80005

EPA S perfund Record C nte
999 18 Street Su t 500
D nv CO 80202

W rd shown n ***bold italics*** on th first m ntion re d fined n th glo sary t th nd f th doc ment

The alternative proposed herein is DOE s recommended alternative for OU 1 DOE EPA and CDPHE will make the final remedy selection after considering comments from the public A summary of responses to all comments will be prepared and included in the ***Responsiveness Summary*** section of the ***Corrective Action Decision/Record of Decision*** (CAD/ROD) The CAD/ROD will be prepared and published by DOE following the public comment period

PUBLIC INVOLVEMENT PROCESS

Community acceptance is one of the criteria that DOE and the regulatory agencies must evaluate during the process of selecting a final remedy Evaluation of community acceptance can be accomplished through a formal public involvement program DOE s program consists of 1) continuing dialogue with citizens on issues of concern such as the ***RCRA Facility Investigation/Remedial Investigation*** (RFI/RI) and 2) seeking citizen participation in the selection of a final remedy at the site This latter component is why the PP is being issued for public review and comment Public interaction is critical to the RCRA/CERCLA process and in making sound environmental decisions

Although this plan identifies *Institutional Controls with the French Drain* as the preferred alternative for OU 1 the public is encouraged to review and comment on all the alternatives not just the preferred alternative The final alternative as presented in the CAD/ROD may be different from the preferred alternative depending upon new information or arguments that the lead agency may consider as a result of public comment Details on individual alternatives can be found in the OU 1 ***Corrective Measures Study/Feasibility Study*** (CMS/FS) Copies of this document are on file in the ***Administrative Record*** and are located at the information repositories presented on page 1 of this plan

The public comment period for this plan will be from _ _____ to _____ A public hearing will be held on _____ Comments on the PP may be submitted orally or in writing at the public hearing or mailed directly to the addresses shown on page 1 Mailed comments must be postmarked no later than _____

Upon timely request the comment period may be extended Such a request should be submitted in writing to DOE postmarked no later than _____ FAILURE TO RAISE AN ISSUE OR PROVIDE INFORMATION DURING THE PUBLIC COMMENT PERIOD MAY PREVENT YOU FROM RAISING THAT ISSUE OR SUBMITTING SUCH INFORMATION IN AN APPEAL OF THE AGENCIES FINAL DECISION

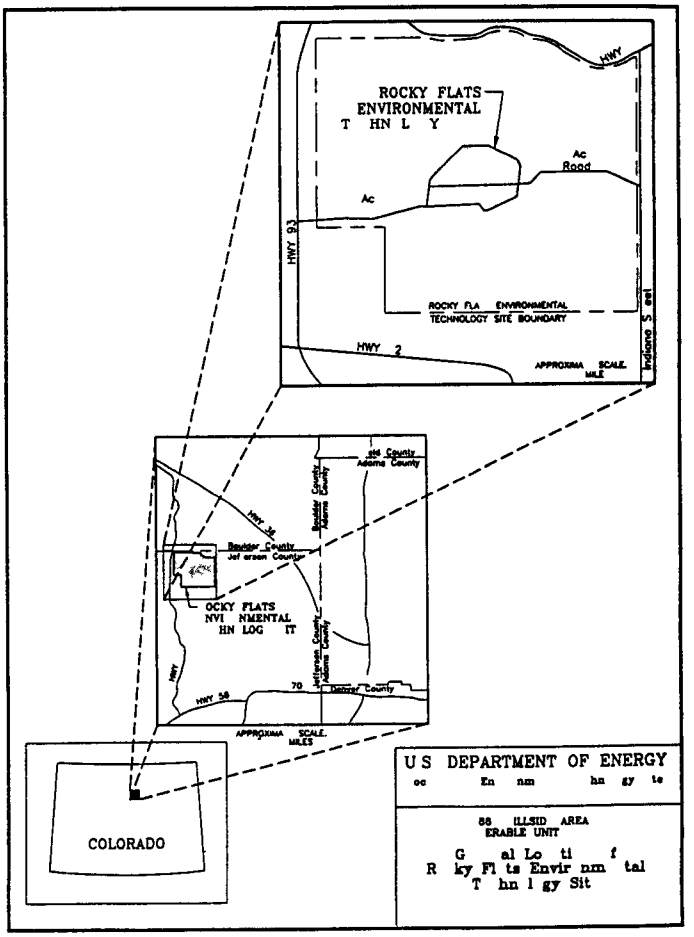
SITE BACKGROUND

Originally the RFETS was named the Rocky Flats Plant (RFP) but in July 1994 the plant was renamed to better reflect its new mission of environmental restoration and the advancement of new and innovative technologies for waste management characterization and remediation

The RFETS is a DOE owned facility located approximately 16 miles northwest of downtown Denver Colorado The RFETS occupies approximately 6 550 acres of federally-owned land in northern Jefferson County Colorado (see Figure 1)

The majority of the RFETS plant buildings are located within a 400 acre area referred to as the RFETS industrial area The 6 150 acres surrounding the plant buildings provide a buffer zone around the secure industrial area

Figure 1



Until 1992 the RFETS fabricated nuclear weapon components from plutonium uranium beryllium and stainless steel Parts made at the plant were shipped elsewhere for assembly Support activities included chemical recovery and purification of recyclable transuranic radionuclides and research and development in metallurgy machining nondestructive testing coatings remote engineering chemistry and physics

The production process at the RFETS resulted in the generation of radioactive and non radioactive wastes On site storage and disposal of these wastes has contributed to hazardous and radioactive contamination in soils surface water and groundwater Due to the complex nature of the RFETS site it has been divided into sixteen Operable Units (OUs) OU 1 the 881 Hillside Area is the subject of this plan (see Figure 2)

Previously Building 881 was used for enriched uranium operations and stainless steel manufacturing The laboratories in Building 881 were also used to perform analyses of materials generated during production of various components The building is located south of the plant on a south facing hillside which slopes down to Woman Creek

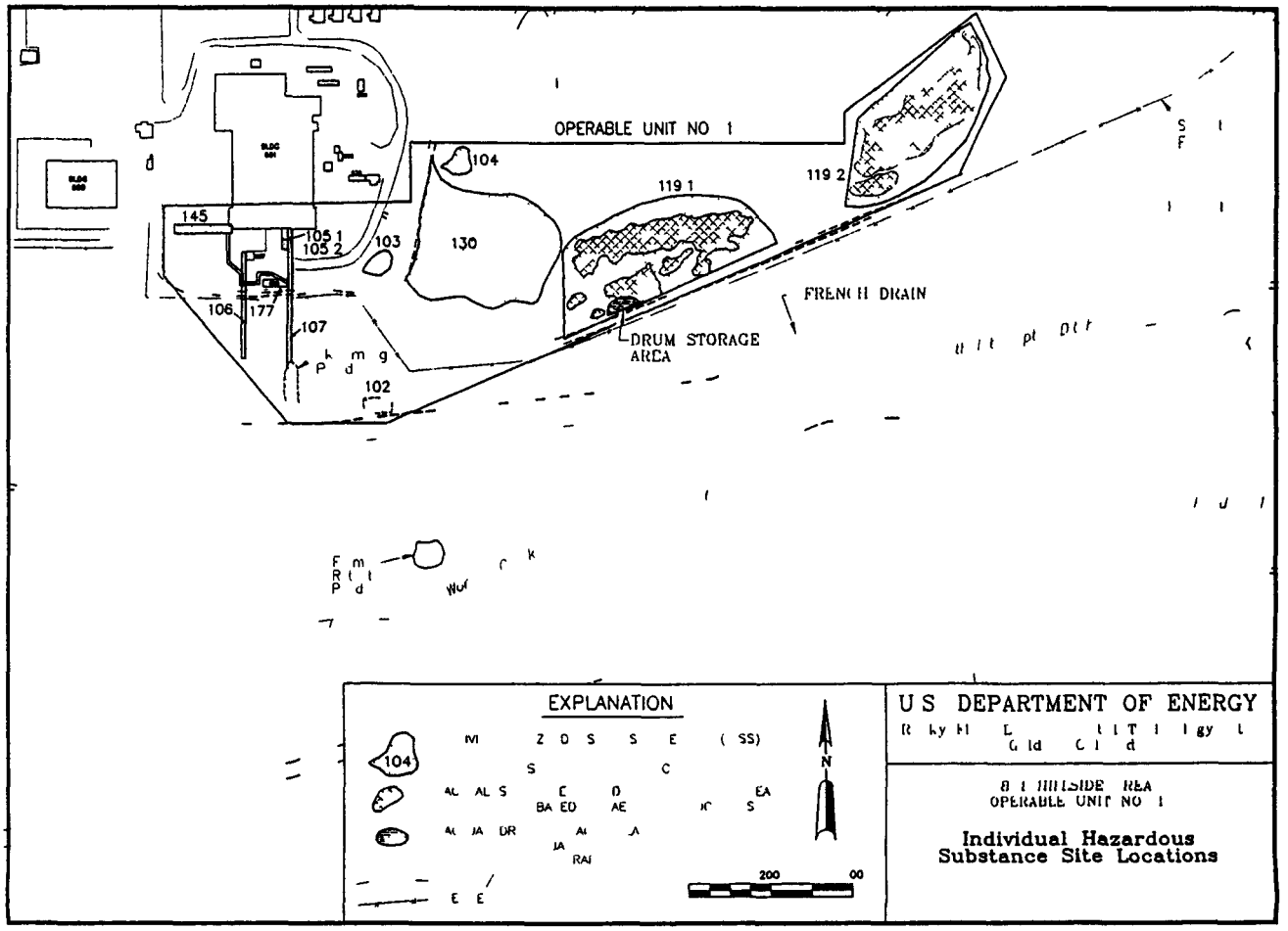
OU 1 includes 11 areas previously identified as ***Individual Hazardous Substance Sites*** (IHSSs) where past operational practices may have resulted in environmental contamination Brief descriptions of the OU 1 IHSSs are presented below

IHSS 102 Oil Sludge Pit Site Area located approximately 180 feet south of Building 881 where 30 to 50 drums of non radioactive oily sludge were emptied in the late 1950s The sludge was generated during the cleaning of two No 6 fuel oil tanks designated as IHSSs 105 1 and 105 2 (listed jointly as IHSS 105 below) The area was backfilled when disposal operations ceased

IHSS 103 Chemical Burial Site A circular pit located approximately 150 feet southeast of Building 881 was identified on 1963 aerial photographs The area was reportedly used to bury unknown chemicals

IHSS 104 Liquid Dumping Site A former (pre 1969) liquid waste disposal pond in the area east of Building 881 The exact location is uncertain due to the poor quality of 1965 aerial photographs

Figure 2



IHSSs 105 Out-of-Service Fuel Oil Tank Sites Located immediately south of Building 881 these storage tanks were for No 6 fuel oil Suspected leaks occurred in 1972 The tanks were closed in place through filling with asbestos-containing material and cement

IHSS 106 Outfall Site An overflow line from the sanitary sewer sump in Building 887 was used for discharge of untreated sanitary wastes in the 1950s and 1960s Due to concerns about discharges from the outfall entering Woman Creek several small retention ponds and an interceptor ditch were built in 1955 and 1979 respectively

IHSS 107 Hillside Oil Leak Site Site of a 1972 fuel oil spill from the Building 881 foundation drain outfall A concrete skimming pond was built below the foundation drain outfall to contain the oil flowing from the foundation drain and an interceptor ditch was constructed to prevent oil-contaminated water from reaching Woman Creek

IHSSs 119 1 119 2 Multiple Solvent Spill Sites Former drum and scrap metal storage areas east of Building 881 along the southern perimeter road The drums contained unknown quantities and types of solvents and wastes The scrap metal may have been coated with residual oils and/or hydraulic coolants

IHSS 130 Radioactive Site 800 Area #1 Area east of Building 881 used between 1969 and 1972 to dispose of soil and asphalt contaminated with low levels of plutonium and uranium IHSS 130 contains plutonium-contaminated soil and asphalt which came from contamination caused by a leaking drum in transit and soil removed from around the Building 774 process waste tanks in 1972

IHSS 145 Sanitary Waste Line Leak A six inch cast iron sanitary sewer line that originated at the Building 887 lift station and that leaked on the hillside south of Building 881 The line had conveyed sanitary wastes and low level radioactive laundry effluent to the sanitary treatment plant from about 1969 to 1973

Note that in 1992 a French Drain was constructed across a significant portion of OU 1 above the South Interceptor Ditch (SID) to collect potentially contaminated alluvial groundwater draining across the hillside This feature was added as part of the OU 1 IM/IRA previously mentioned Groundwater is collected in the drain and pumped to the UV/H_2O_2 and ion-exchange treatment processes located in Building 891 (hereinafter referred to as the Building 891 water treatment system) A granular activated carbon unit from OU 2 is also expected to be added to the treatment process

SUMMARY OF SITE RISKS

As detailed in the Phase III RFI/RI report risks associated with OU 1 are associated primarily from exposure to groundwater contaminants Surface soil contamination from OU 1 is being addressed administratively with surface soil contamination in OU 2 Although groundwater is not available for current residential use the scenario of a residence situated directly above the most contaminated zone in the operable unit has been analyzed in the RFI/RI report The results of this scenario are that a risk above 10^{-} would result to an on site receptor within IHSS 119 1 in OU 1 without institutional controls This is above the acceptable risk range according to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) guideline of one in ten thousand to one in a million

The primary organic contaminants identified in the Phase III RFI/RI in groundwater are the following

carbon tetrachloride
1 1 dichloroethene
tetrachloroethene
1 1 1 trichloroethane
trichloroethene

No significant environmental risks were identified in the Phase III RFI/RI and therefore environmental risks did not warrant further examination In addition no off-site risks were identified in the ***Baseline Risk Assessment*** (BRA) that exceeded any regulatory or health based standards

The following ***Remedial Action Objectives*** (RAOs) have been set in accordance with EPA guidance for protection of human health and environmental receptors from potential adverse effects of groundwater contaminants

1) Prevent the inhalation of ingestion of and/or dermal contact with VOCs and inorganic contaminants in OU 1 groundwater that would result in a total excess cancer risk greater than 10^{-4} to 10^{-6} for carcinogens and/or a hazard index greater than or equal to one for non-carcinogens

2) Prevent migration of contaminants from subsurface soils to groundwater that would result in groundwater contamination in excess of potential

groundwater applicable or relevant and appropriate requirements (ARARs) for OU 1 contaminants

3) Prevent migration of contaminants in OU 1 groundwater from adversely impacting surface water quality in Woman Creek

These RAOs were used to formulate appropriate remedial action alternatives for OU 1 groundwater

SUMMARY OF REMEDIAL ACTION ALTERNATIVES

The following remedial action alternatives were identified and subjected to a detailed analysis to identify a preferred remedy for OU 1

Alternative 0 No Action This alternative was identified as a baseline against which other alternatives could be compared Under this alternative the French Drain would be decommissioned and the site would be released for unrestricted use

Alternative 1 Institutional Controls with the French Drain This alternative represents the existing conditions at OU 1 Under this alternative the existing French Drain would continue to collect groundwater flowing from the 881 Hillside Area and treat it when necessary using the existing Building 891 water treatment system

Alternative 2 Groundwater Pumping and Soil Vapor Extraction This alternative consists of pumping the groundwater found beneath the IHSS 119 1 area (the most contaminated region in OU 1) to remove groundwater from the ***saturated zone*** to the maximum extent practical and then applying ***soil vapor extraction*** (SVE) to remove contaminants found in the subsurface soil zone Extracted groundwater would be treated using the existing Building 891 water treatment system and extracted vapors would be treated via ***carbon adsorption*** or ***catalytic oxidation***

Alternative 3 Groundwater Pumping and Soil Vapor Extraction with Thermal Enhancement This alternative is identical to the preceding alternative except that it includes heating subsurface soils prior to implementing SVE to increase the treatment range of the vapor extraction system Subsurface soils would be heated through either ***radio frequency*** (RF) heating or ***ohmic (electrical resistance) heating*** Contaminant extraction efficiencies would be increased through heating by assisting the ***volatilization*** of contaminants and by opening blocked ***pore spaces*** in the soil matrix

Alternative 4 Hot Air Injection with Mechanical Mixing This alternative utilizes a drill rig with a large wide bladed auger to forcefully mix subsurface soils while injecting steam to help volatilize and extract contaminants Groundwater present at the drilling point would be extracted through the hollow auger and would be treated using the existing Building 891 water treatment system

Alternative 5 Soil Excavation with Groundwater Pumping This alternative targets removal of the most contaminated soils beneath IHSS 119 1 Although the primary concern at OU 1 is groundwater contamination this alternative would remove any potential residual sources of contamination found in the soils themselves while extracting groundwater for treatment in the existing Building 891 water treatment system Excavated soils would be thermally treated on site and shipped off site to a licensed facility for ultimate disposal

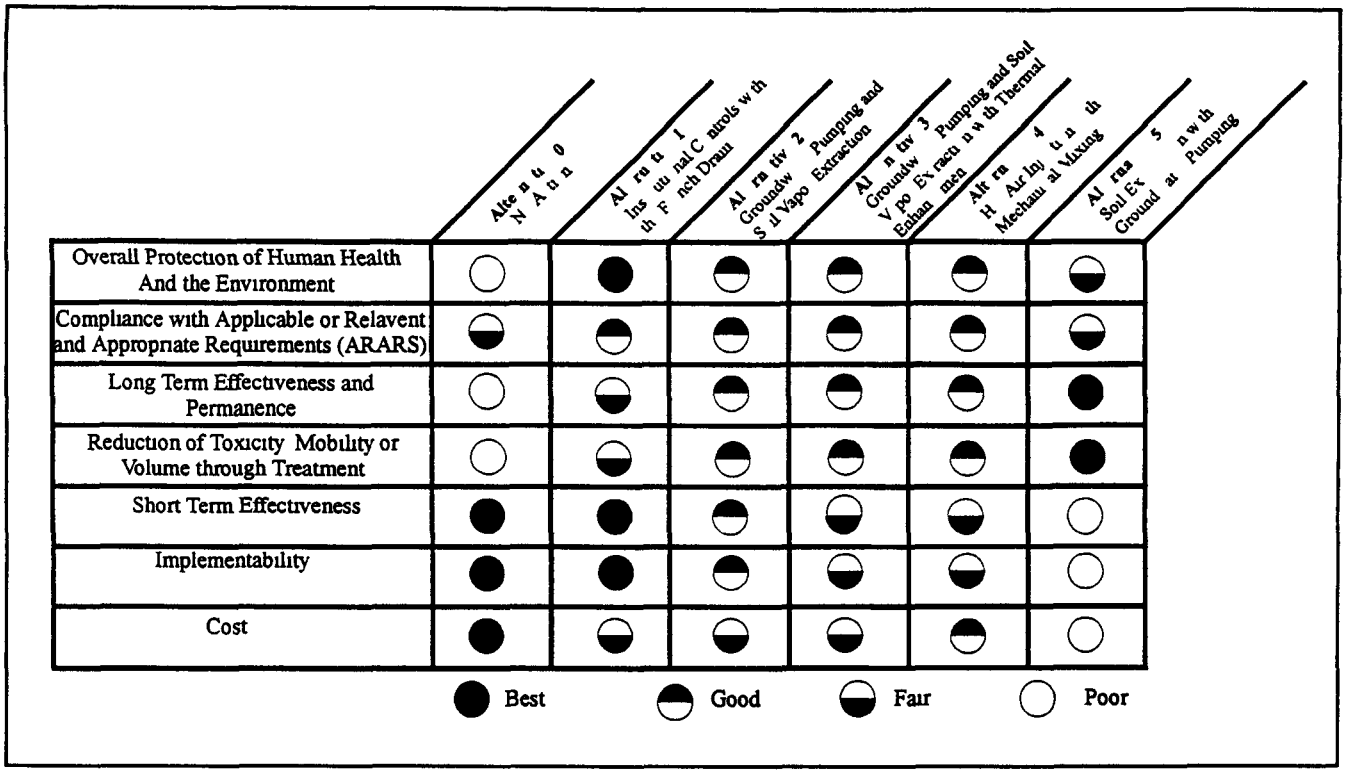
SUMMARY OF DETAILED ANALYSIS OF ALTERNATIVES

The detailed analysis of alternatives conducted as part of the CMS/FS evaluated each of the remedial action alternatives with respect to the following criteria Figure 3 presents the comparison graphically

- **Overall Protection of Human Health and the Environment** This is a threshold criterion and is used to evaluate the conclusions of other criteria The criterion is used to evaluate how human health and environmental risks are eliminated reduced or controlled through treatment engineering controls or institutional controls

  Alternative 1 has been determined to be the most protective of human health and the environment due to its immediate impact on containing OU 1 contaminants while minimizing short term risks to workers and the public Environmental impacts from remediation activities are also minimal with this alternative Alternatives 2 3 and 4 were deemed the next most protective since they would create some environmental damage as a result of remediation activities Alternative 5 offers the next highest level of overall protection since it removes

Figure 3



contaminated media from OU 1 groundwater although widespread damage would result to the vegetation and wildlife in the immediate vicinity Alternative 0 offers the least protection of the alternatives considered since it does not include any source removal or containment

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) This criterion evaluates the degree to which the various alternatives meet chemical specific action specific and location specific requirements ARARs are requirements that would apply to the site contaminant or action if the remedial action was not being conducted under CERCLA ARARs are also requirements that apply to similar activities locations or chemicals and that are deemed appropriate for the particular proposed remedial action

Section 121(d) of CERCLA requires remedial actions to comply with the ARARs designated at a site Key potential ARARs analyzed for each alternative include

Colorado Basic Standards for Groundwater 5 CCR 1002 8 3 11 5 and 3 11 6

Colorado RCRA Regulations 6 CCR 1007 3 Parts 264 and 268 and proposed changes to Part 261

Colorado Air Pollution Control Regulations 5 CCR 1001 5 Regulation 7

Colorado Nongame Endangered or Threatened Species Conservation Act CRS 33 2 101

All alternatives should meet Colorado groundwater protection standards at Woman Creek All the alternatives evaluated in the detailed analysis also should meet the other key potential ARARs identified above Alternative 1 ranked slightly higher than Alternatives 2 3 and 4 because Alternatives 2 3 and 4 require significant site disturbance associated with remedial activities Compliance with State laws on non game species and federal regulations on wetlands protection would be needed for the surface disturbance activities Alternative 5 ranked lowest due to the severely intrusive nature of excavation activities and the associated ARARs Alternative 0 ranked the lowest because it was the least likely to meet groundwater protection standards at Woman Creek

Long Term Effectiveness and Permanence This criterion evaluates the long term protectiveness and permanence of the alternatives Preference is given to treatment alternatives since they involve removal

of the contaminants or conversion of contaminants to an innocuous form

Alternatives 2 3 4 and 5 provide the highest level of long term effectiveness and permanence since they remove both groundwater contamination and potential residual subsurface sources from OU 1 Alternatives 2 3 4 and 5 provide a permanent solution Alternative 1 provides the next highest level of effectiveness and permanence since it involves collection and treatment of contaminated groundwater and thus reduces contamination at OU 1 permanently Alternative 0 ranks lowest under this criterion since it does not treat or remove any contamination

Reduction of Toxicity Mobility or Volume Through Treatment This criterion evaluates the ability of the alternatives to reduce the risks at the site through destruction of contaminants reduction of the total mass of contamination reduction of contaminant mobility or reduction of contaminated media volume The NCP and RCRA guidance give preference to alternatives that involve treatment

Alternatives 2 3 4 and 5 provides the highest level of toxicity mobility and volume reduction since they target the contaminant source area identified at IHSS 119 1 Alternative 1 provides the next highest level of reduction since it would collect and treat contaminated groundwater thereby reducing the volume of contaminated media and preventing contaminant migration away from OU 1 Alternative 0 provides no reduction in toxicity mobility or volume of contaminants

Short Term Effectiveness This criterion evaluates community environmental and site worker protection during the construction and implementation of the remedy

Alternatives 0 and 1 rank highest under this criterion since they involve no disturbance of the existing site and little or no worker involvement Alternative 2 3 and 4 rank next under short term effectiveness since they involve risk to workers involved in source remediation Alternative 2 would have minor environmental impacts from drilling while Alternatives 3 and 4 would involve significant short term environmental impacts from heating and augering respectively Alternative 5 ranks lowest with severe environmental disturbance risk to workers and potential community risk from contaminated dust produced during excavation

Implementability This criterion evaluates the technical and administrative feasibility of implementing the alternatives including the availability of materials and services needed during implementation This criterion is especially important for evaluating reliability of less proven technologies or those that rely on limited supplies of equipment vendors or specialized workers

Alternatives 0 and 1 are the most implementable since only the continuation of current interim measures is involved Alternatives 2 3 and 4 rank lower since they utilize intrusive treatments that would make technical implementability more difficult Also off gas air quality requirements and other administrative requirements would reduce administrative implementability Alternatives 3 and 5 are the least implementable both technically and administratively since they require severe site intrusion Administrative and technical difficulties would be significant for these alternative In particular Alternative 5 could require consultive meetings with the Fish and Wildlife Service to determine the implementability of the alternative given the potential ecological damage associated with this alternative

Cost This criterion evaluates the capital cost for each alternative long term operation and maintenance (O&M) expenditures required to sustain it and post-closure costs occurring after the completion of remediation Future expenditures are adjusted to present worth amounts by discounting all costs to a common base year using present worth cost analysis

Alternative 0 is the least costly since it involves only the continuation of groundwater monitoring The total estimated costs of alternatives 0 is $1 804 200 Alternative 4 is the next least costly with an estimated total cost of $6 015 100 Alternatives 4 is actually less costly than Alternative 2 due to the remediation time frame reduction associated with thermal enhancement The total estimated costs for Alternative 2 is $7 046 600

Alternative 3 has a higher total cost than Alternative 2 resulting from the addition of thermal treatment The total estimated cost of Alternative 3 is $7 560 500 Alternative 1 has a total estimated cost of $7 565 400 which is higher than alternatives 0 2 3 and 4 due to the continued operation of the Building 891 water treatment facility for 30 years Alternative 5 involves excavation of a large area and therefore has the largest capital costs for a total estimated cost $13 269 600

State Acceptance This criterion addresses the State or support agency s comments and concerns regarding the appropriateness of the proposed alternative This evaluation is presently ongoing through agency review and comment resolution activities Results of this evaluation will be included in the CAD/ROD

- **Community Acceptance** This criterion is used to evaluate the proposed remedial action alternatives in terms of issues and concerns raised by the public Public involvement is encouraged through public hearings and the submittal of public comments The selection of a final remedy will include an evaluation of public concerns and objections Community acceptance will be discussed in the CAD/ROD

PREFERRED REMEDIAL ALTERNATIVE

The OU 1 CMS/FS detailed analysis of alternatives demonstrates that *Institutional Controls with the French Drain* is the preferred alternative for groundwater remediation Groundwater modeling conducted to support the CMS/FS indicates that under this alternative groundwater ARARs should be met at Woman Creek This alternative results in a comparable cost with other alternatives while still achieving a residual risk level for a future on site resident of less than one in a million at the creek

This alternative therefore meets both of the threshold criteria identified in the NCP Overall Protection of Human Health and the Environment and Compliance with ARARs as well as providing long term effectiveness and permanence through the use of the Building 891 water treatment system and the existing French Drain The alternative also meets the RCRA standard of controlling sources although the primary source is not immediately remediated

The toxicity mobility and volume of OU 1 groundwater contaminants would be reduced through treatment in the Building 891 water treatment system as well as through natural ***dispersion biodegradation*** and ***volatilization*** In terms of short term effectiveness and implementability this alternative is one of the most implementable alternatives proposed which results in the lowest short term risks to workers the public and the environment This alternative results in a moderate present worth cost because institutional controls are currently in place at the RFETS Monitoring would be continued under this alternative throughout the institutional control period to observe contaminant concentrations and to determine when groundwater collected by the French Drain requires treatment

It is assumed that six monitoring points will be used for demonstrating compliance with the performance monitoring system of this alternative Up to four new wells will be installed one deep and shallow well cluster downgradient of IHSS 119 1 upgradient of the French Drain and possibly two additional wells upgradient of Woman Creek Geological and geophysical support such as photographic lineament analysis and/or three-dimensional seismic surveys could be used to assist in the placement of the well cluster This would enable paleochannels and faulted zones to be clearly identified prior to well placement

Samples will also be collected from the french drain sump to monitor performance Samples will be collected semiannually and analyzed for organic and inorganic contaminants Analysis of individual species of inorganic contaminants would also be performed to identify individual metal species which have the potential to bioaccumulate This additional analysis requirement will only be performed occasionally in the sampling program

GLOSSARY

Administrative Record The record of documents including correspondence public comments technical reports etc upon which the agencies based their remedial action selection

Baseline Risk Assessment (BRA) An assessment of the risks to human health and the environment at a site The methodology employed in risk assessment uses contaminant concentrations and potential exposure routes to quantify risks associated with present and future site conditions

Biodegradation The breakdown of contaminants to other chemical or physical forms by bacteria fungi and other microorganisms

Carbon Adsorption A treatment which traps organic and some inorganic contaminants from air or water on an activated carbon surface as the contaminated stream is passed through a carbon containing vessel The contaminated carbon can be destroyed or regenerated

Catalytic Oxidation A treatment which destroys organic contaminants in an air stream by oxidizing the contaminants in a special reaction vessel The vessel

contains a catalyst which speeds the oxidation and lowers the temperature needed for complete oxidation

Corrective Action Decision/ Record of Decision (CAD/ROD) A public document that explains which cleanup alternative(s) are selected at a RCRA/CERCLA site The CAD/ROD is based on information obtained from the RFI/RI the CMS/FS and community participation

Corrective and Remedial Action Proposed Plan (PP) The public document that first introduces the lead agency s preferred alternative for site remediation The PP is produced through the cooperation of the lead and regulatory agencies and is reviewed by the public

Corrective Measures Study/ Feasibility Study (CMS/FS) The CMS/FS identifies and evaluates the most appropriate technical approaches for addressing environmental contamination Specific factors from CERCLA and RCRA guidance are assessed through this study

Dispersion The distribution of contamination within a larger volume resulting in lower concentrations as the plume disperses

French Drain An underground structure consisting of loose stones covered by soil The result is groundwater collection in sumps or diversion of flow in a particular direction

Individual Hazardous Substance Site (IHSS) An area which has been identified as being potentially contaminated as a result of previous operations or disposal practices

Interim Measure/ Interim Remedial Action (IM/IRA) An early action taken to control a release or threatened release of hazardous substances

Ohmic (Electrical Resistance) Heating The use of six phase electrical power to heat subsurface soils and increase contaminant volatilization The process uses grids of six antennae placed in a hexagonal well array

Pore Spaces The small spaces between soil particles which can be occupied by water or air Pore spaces may or may not be open to transport groundwater

Radio Frequency (RF) Heating The use of radio frequency energy to heat subsurface soils and increase contaminant volatilization Antennae are placed in vertical or horizontal wells and produce radio waves which heat the surrounding soils

RCRA Facility Investigation/ Remedial Investigation (RFI/RI) The RFI/RI involves collecting and analyzing information to determine the nature and extent of contamination that may be present at a site This may include risk assessment and modeling activities

Remedial Action Objectives (RAOs) RAOs are contaminant and medium specific goals for protecting human health and the environment

Responsiveness Summary The part of the CAD/ROD that summarizes public and agency comments and provides responses to those comments

Saturated Zone The portion of the subsurface which is completely saturated by groundwater that is the area of soil beneath the water table

Soil Vapor Extraction (SVE) An in situ treatment for organic contamination in subsurface soils which transfers contaminants from the soil and water in pore spaces to air Contaminants are then removed from the subsurface by extraction wells fitted with vacuum pumps

UV/H_2O_2 A treatment which combines exposure of contaminated water to ultraviolet light (UV) with the addition of hydrogen peroxide (H_2O_2) Both provide free radicals which catalyze the breakdown of contaminants to innocuous chemicals

Volatilization The act of changing from a liquid state to a gas state This action can be accelerated through the addition of heat or through reducing ambient pressure conditions